INFRASONIC WILDFIRE DETECTION DEVICE

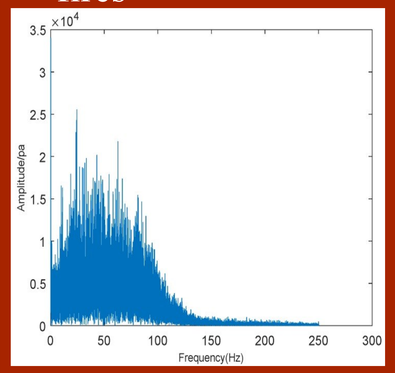
Carlos Santos, Cory Holt, Andrew Malinowski, and Meridian Haas

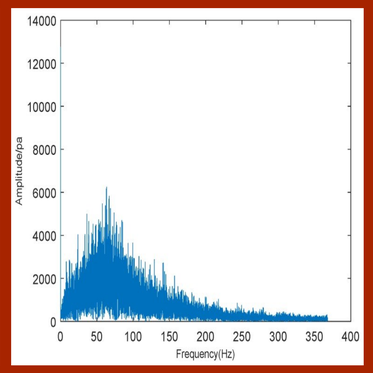
Objective:

- Create a mesh network of infrasonic wildfire sensors.

Background:

- Wildfire produces infrasound
- Plots of Infrasound response from different fires





- Crown Fire:
  - 0 – 350 Hz
- Surface Fire:
  - 0 – 15 KHz

Value Proposition:

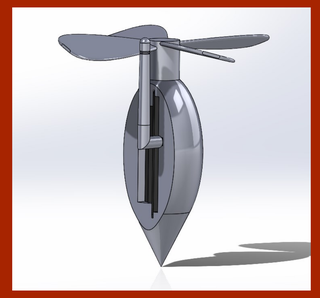
- Currently, our best means of wildfire detection is by seeing and smelling smoke.
- The ability to provide a signal to firefighting services when the fire is still small could save countless homes and wilderness areas.

Key Requirements:

- Cheap!
- Accurately detects sound waves in the 0-20 Hz range.
- Small and rigid construction.
- Capable of withstanding drops
- Creates a network of like devices for resilient data transmission

Design so far…

Enclosure Design

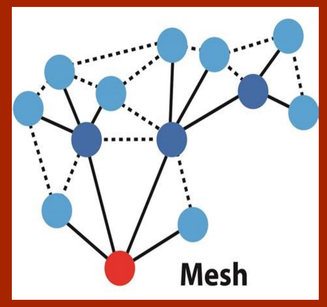


- Helicopter design to slow falling speeds
- Oval Shape to hold components

Development board – TTGO T-Beam

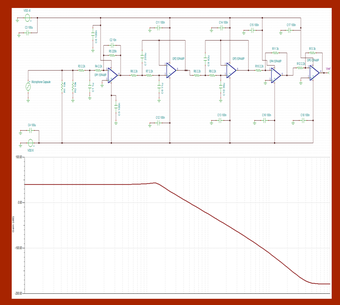
- ESP32 MCU
- LoRa Transceiver
- GPS Module
- WiFi/Bluetooth

Network design



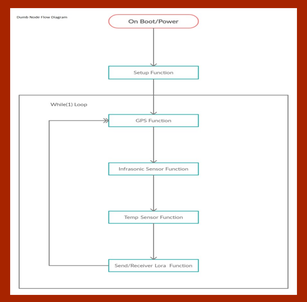
- Mesh Network
- Smart and Dumb Nodes
- Simple radio packets
  - Fire/No Fire

Amplifier and Filter

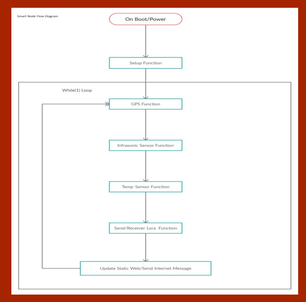


- Multi-stage Chebyshev Filter
- Adjustable-gain amplifier
- Isolate and boost signals from the 0-20 Hz band.

Dumb Node Flow



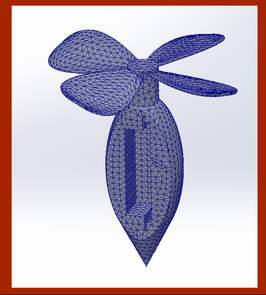
Smart Node Flow

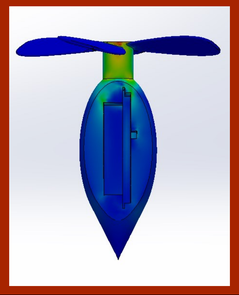


Validation:

- Simple LoRA Distance Test
  - Roughly ~1 mile line of sight
  - 1 packet per second
  - Red dots packets received

- Force Simulation in SolidWorks
  - Simulated a force of 5 N on the downward side of the enclosure.





Plans for Future:

- Microphone Testing with Breadboard Circuit
- PCB Design and Printing
- Enclosure Simulations
- Drop Tests
- 3D Print on a Larger Scale
- Testing and Code Validation
- Battery Purchase and Testing

Acknowledgements:
Joe Stanley
Dr. Herb Hess
Dr. Feng Li